Product User Manual

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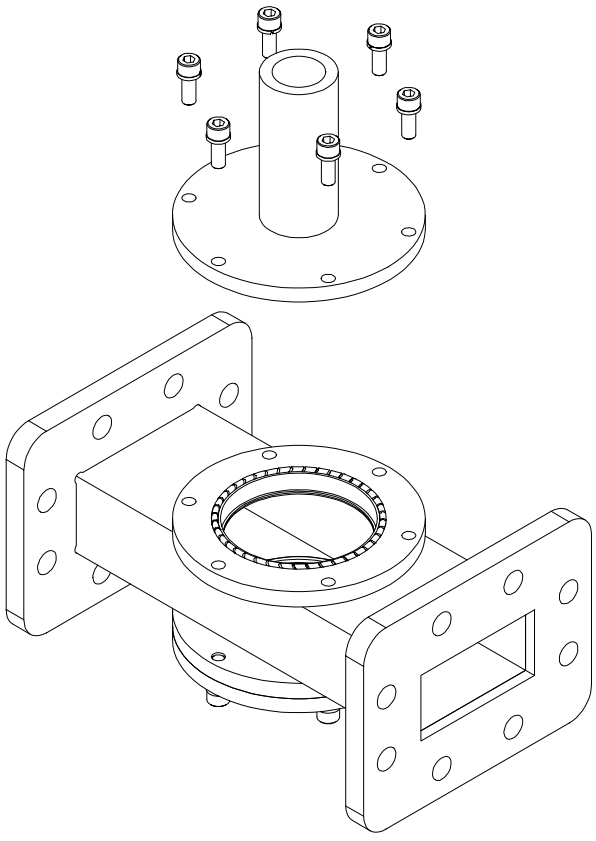
Model GA8306 Series
Test Tube Adapter, 5.8 GHz



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REV.	**DESCRIPTION**	**DATE**	**APPROVAL**
1	PROTOTYPE RELEASE	15JAN04	JFG

WARRANTY

Products manufactured and sold by Gerling Applied Engineering, Inc. ("GAE") are warranted to be free of defects in materials and workmanship under normal use and service for a period of twelve (12) months from the date of original shipment. GAE's obligation under this warranty is limited to repairing or replacing, at GAE's option, all non-consumable component parts. Consumable parts are specifically excluded from this warranty and may include, but are not be limited to, magnetrons, fuses, lamps, seals, o-rings, v-belts, and fluids. All warranty repairs are to be done at GAE's facility or as otherwise authorized by GAE. All shipping charges for warranty repair or replacement are the purchaser's responsibility unless otherwise agreed to by GAE.

This warranty supercedes all other warranties, expressed or implied. No warranty is given covering the product for any particular purpose other than as covered by the applicable product specifications. GAE assumes no liability in any event for incidental or consequential damages, financial losses, penalties or other losses incurred in conjunction with the use of GAE products.

DOCUMENT CONVENTIONS

NOTE: *Means the reader should take note. Notes contain helpful information, suggestions, or references to other sections, chapters, or documents.*

CAUTION: *Means the reader should be careful. You are doing something that might result in equipment damage or loss of data.*

WARNING: *Means danger. A situation exists that could cause bodily injury or death. All personnel must be aware of the hazards involved with high voltage electrical circuitry and high power microwave devices.*

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WARNING

All waveguide applicators and accessories manufactured by GAE, Inc. are intended for use with other equipment capable of producing a microwave field that is potentially hazardous to operating personnel. They must never be connected or operated in a manner that allows a field in excess of 10 milliwatts per square centimeter to be generated in an area accessible to operating personnel. Contact GAE, Inc. for technical support prior to installation and/or operation of these units if there is any question or concern about microwave leakage.

All waveguide flange and electrical cable connections throughout the system must be secure prior to operation. Never operate the microwave generator without a properly rated absorbing load attached. To ensure safe operation and prevent microwave leakage, the equipment must be periodically inspected and maintained as required or recommended.

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EQUIPMENT DESCRIPTION

The model GA8306 series Test Tube Adapter provides a safe and convenient means to secure a test tube inside a waveguide for purposes of heating a small sample of material by microwave energy. It is specifically designed for use with WR159 versions of the GAE model GA600x series Universal Waveguide Applicator (UWA) which can be adapted for laboratory heating of a variety of material samples.

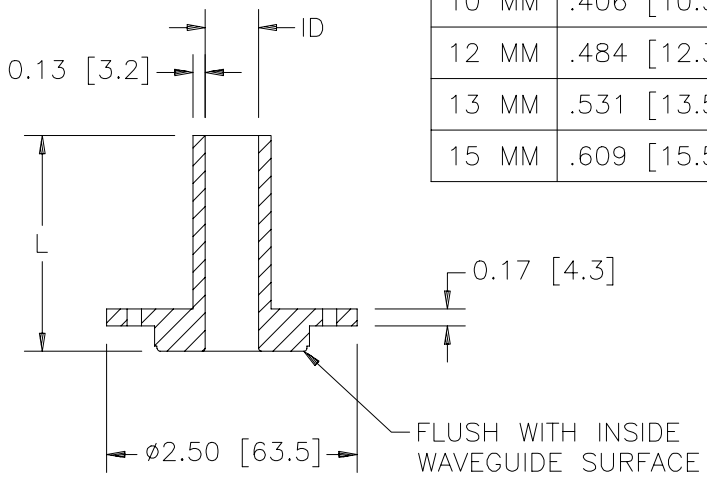
The basic concept of the GA8306 is that of a “cut-off tube” whereby the inside diameter and length are determined to prevent excess microwave leakage. Designed for standard test tube sizes between 6 mm and 15 mm OD, the GA8306 can also be used for heating materials that are inserted through the tube and into the waveguide. When used in pairs with a dual sided UWA, the GA8306 provides a means to heat extrusions or fluids on a continuous flow basis.

General Specifications

Frequency	5.8 GHz nominal
Construction	6061-T6 aluminum alloy
Finish	Clear chemical film

Outline Drawing

CONFIGURATION TABLE		
SIZE	ID	L
6 MM	.250 [6.4]	1.31 [33]
8 MM	.328 [8.3]	1.38 [35]
10 MM	.406 [10.3]	1.50 [38]
12 MM	.484 [12.3]	1.75 [44]
13 MM	.531 [13.5]	2.12 [54]
15 MM	.609 [15.5]	2.50 [64]



INSTALLATION

Preliminary Inspection

Upon arrival at the installation site the GA8306 series Test Tube Adapter should be thoroughly inspected for damage or wear caused during shipping. Any visible damage to the packaging material or the adapter itself should be noted and reported immediately to the shipping company in accordance with standard claims procedures.

The following components are included:

a) GA8306 series Test Tube Adapter

b) Product User Manual (this document)

Waveguide Configuration

The applicator with which the GA8306 adapter will be used can be connected to and used with any common waveguide component having a compatible flange (see below). Mounting can be in any convenient position and orientation with either flange positioned towards the microwave generator. Ideally, the applicator should be located as close to the tuner as possible. Figure 1 illustrates a typical waveguide configuration.

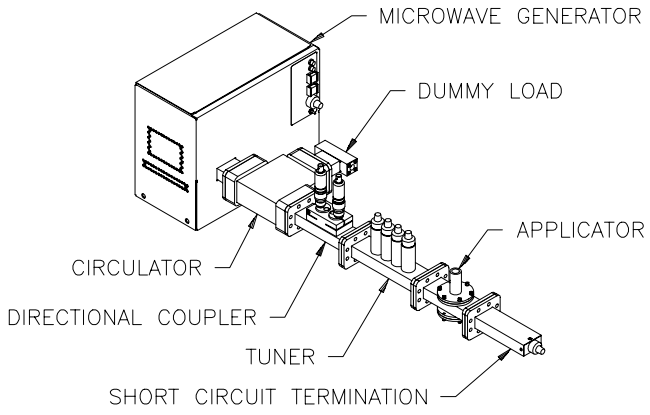


Figure 1. Typical waveguide configuration for process heating.

Flange Connections

Both flanges of the applicator must be properly connected to another waveguide component. Bolts and nuts must be installed at all flange bolt holes on both flanges prior to operation.

Microwave Leakage – Regulatory limits for microwave leakage relate to standards for human safety and interference with other electronic devices. Standards for human safety as adopted by OSHA, the International Electrotechnical Commission (IEC) and

other regulatory agencies limit leakage to 5 mW/cm^2 measured at 5 cm from the leakage source under normal operating conditions, and 10 mW/cm^2 at 5 cm from the source under abnormal operating conditions. The U.S. Federal Communications Commission (FCC) has established regulations limiting the emission of energy at frequencies outside the ISM bands. All GAE waveguide components meets these requirements when properly connected to another waveguide component.

Test Tube Adapter Installation

The GA8306 adapter is designed for installation onto the model GA600x series Universal Waveguide Applicator. The GA600x has ports on one or both sides which are covered with blank adapter plates (installed at the factory). These blank plates should be removed only when installing the GA8306 or another suitable adapter in its place.

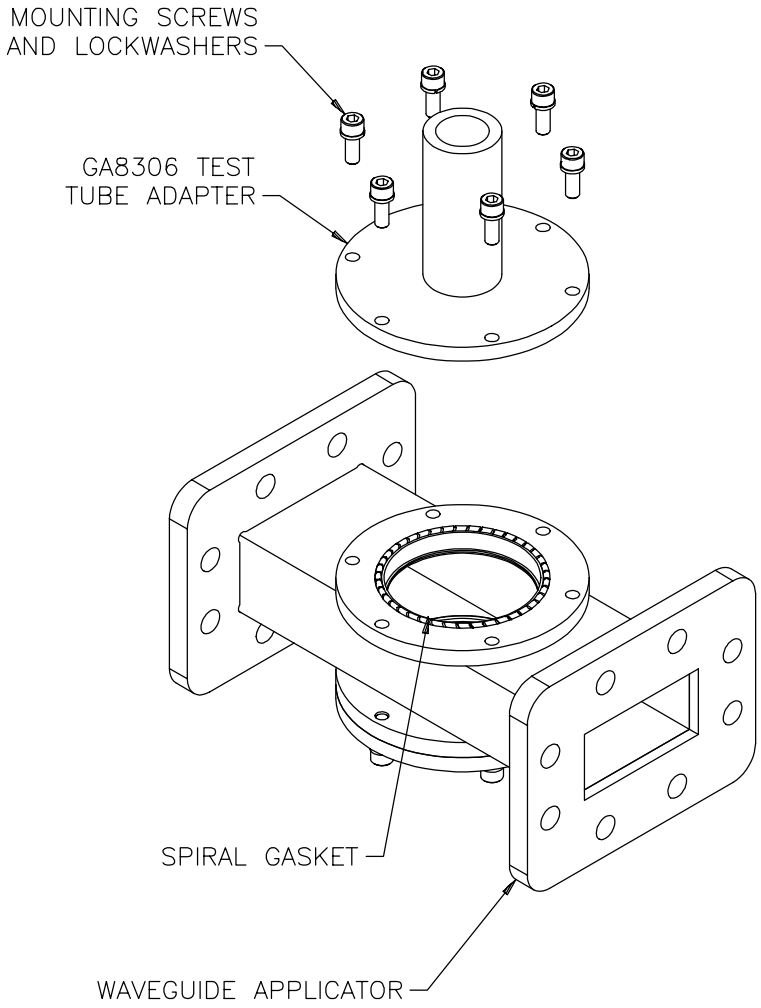
To install the GA8306, first remove the blank adapter plate by loosening the six mounting screws holding it in place. Be sure to retain the screws and washers as they are needed to secure the GA8306 in place.

When installing the GA8306 adapter, be sure the spiral gasket is in place inside the groove surrounding the port opening. The absence of or damage to this gasket can allow excessive microwave leakage. Ensure that all mounting screws are in place and tightened securely.

WARNING: *All ports of the Universal Waveguide Applicator must be covered prior to operation of the microwave generator. Failure to adequately cover all ports can result in injury or death due to excessive microwave radiation.*

Microwave Leakage – As with all waveguide flange connections, microwave leakage from the end of the adapter tube should be checked and monitored periodically to ensure safe leakage levels. It is recommended that leakage be checked upon installation and after insertion of any new load material. Standards for human safety as adopted by OSHA, the International Electrotechnical Commission (IEC) and other regulatory agencies limit leakage to 5 mW/cm^2 measured at 5 cm from the leakage source under normal operating conditions, and 10 mW/cm^2 at 5 cm from the source under abnormal operating conditions.

Assembly Drawing



OPERATION

Design Principle

The basic concept of the GA8306 is that of a "waveguide beyond cut-off" whereby its inside diameter small enough to prevent microwave energy from propagating freely. Microwave energy is attenuated at a rate which is dependent upon the inside diameter, with smaller diameters having a greater rate of attenuation. The presence of any filler materials may also have an impact on the effective inside diameter. The length of the GA8306 is determined for a given inside diameter such that a sufficient amount of attenuation is ensured to prevent excessive microwave leakage from the end of the tube (see also GAE Application Bulletin # 960005 for more information on cut-off tube design).

Basic Use

The effective diameter of a "cut-off" tube is increased if dielectric materials are inserted. Thus, the length required for sufficient attenuation is increased it is filled or partially filled by a dielectric material. The overall length of the GA8306 adapter has been chosen to prevent excess microwave leakage when the tube is empty or filled with a dielectric material having a relatively low dielectric constant. However, in some cases it is possible to cause excess leakage by only partial filling with a high dielectric constant material.

EXAMPLE: *Inserting an empty standard Pyrex® test tube into the GA8306 will fill the cut-off tube only partially by a thin section of a low dielectric constant material ($\varepsilon' \sim 4$). This will have negligible impact on the effective inside diameter and attenuation of microwave energy. However, if the test tube is completely filled with water ($\varepsilon' \sim 77$) then the effective diameter of the cutoff tube will be increased approximately by a factor of 8 and very likely result in excess leakage.*

EXAMPLE: *Suppose a thick wall Teflon tube is used to transport water through the adapter (as in the case of a continuous flow water heater). Even though the diameter of the water column may be small compared to the cut-off tube diameter, the water can act as the center conductor of a coaxial transmission line and result in excess leakage.*

Materials contained inside the test tube but only within the waveguide interior after the test tube is inserted into the GA8306 will not have an affect on microwave leakage. However, we

encourage you to contact GAE for advice and answers to questions about specific materials or heating configurations.

WARNING: *Under any circumstances, metal objects must never be inserted into the GA8306 adapter while microwave power is being generated. Inserting metal objects such as thermocouple probes or wires can result in arcing and/or injury or death due to excessive microwave leakage.*

MAINTENANCE AND CALIBRATION

The GA8306 series Test Tube Adapter is designed to be maintenance free and does not require any user maintenance under normal operating conditions. No calibration is necessary.

However, the spiral gasket supplied with the GA600x Universal Waveguide Applicator may be subject to damage after repeated installations of the GA8306 adapter. Replacement gaskets, GAE part number 420301-063, may be purchased by contacting GAE directly.

Although the GA8306 adapters are very rugged and stable devices, they can be subject to damage due to mishandling or improper use. If damage occurs, the adapter should be returned to GAE for repair or replacement. Contact GAE for information on repair services.

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